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THE MICROSCOPE.

NO. I.

THE microscope, derived from the Greek *mikros*, small, and *skopeo*, to see, is an instrument for viewing minute objects; and it apparently magnifies objects, because they enable us to see them nearer than with the naked eye, without affecting the distinctness of vision. By making a pinhole through a piece of paper, then bringing the eye close to the hole, and the paper within two or three inches of any small object, the object will apparently be much magnified, though without the paper, it would at that distance have been imperceptible.

There are three kinds of microscopes; the single, the compound, and the solar.

Single microscopes, of the greatest power, are very small globules, of glass, which are made by melting the ends of fine threads of glass in the flame of a candle; or by taking a little fine powdered glass on the point of a very small needle, and melting it into a globule. With such microscopes as these, Leuwenhoek made all his wonderful discoveries. The most wonderful single microscopes are those lately made of diamond. The *compound microscope* consists of at least two lenses, by one of which an image is formed within the tube of the microscope; and this image is viewed through the eyeglass, instead of the object itself, as in the single microscope. The microscope being intended only for minute objects, the object lens is consequently of a short focus, and the eyeglass, in this case, is not of so high a magnifying power as in

the telescope. The *solar microscope* is a kind of a camera obscura, which, in a darkened chamber, throws the image on a wall or screen. It consists of two lenses fixed opposite a hole in a board or window-shutter. There is also a plain reflector placed without, moved by a wheel and pinion, which may be so regulated as to throw the sun's rays upon the outer lens. The *lucernal microscope*, invented by Mr. Adams, is also a kind of camera obscura; only the light, in this latter case, proceeds from a lamp instead of from the sun, which renders it convenient to be used at all times.

Nature shows her wonders in the minutest as well as in the largest objects. It is our senses which are not sufficiently acute to perceive the organization of very small bodies, which often escape our observation unless we have recourse to foreign assistance. The microscope has opened to us a new world of insects and vegetables; it has taught us that objects, invisible to the naked eye, exist, having figure, extension, and different parts. Every grain of sand when examined by the eye appears round, but with the help of a glass, we observe each grain differs from the other, both in size and in figure; some of them are perfectly round, others square, some conical, and the major part of an irregular form. What is still more astonishing, by microscopes which magnify objects millions of times their natural size, we can discover, in the grains of sand, a new animal world; for within their cavities, dwell various insects. One of the most wonderful displays in nature is a drop of putrid water, exhibited in a powerful valve microscope, by means of which it covers a space of nine feet in diameter. It is full of living creatures of the strangest shapes, and as their motions are magnified, the rapidity with which they appear to move is perfectly astonishing. In the vegetable kingdom we are presented with a thick forest of trees and plants, bearing leaves, branches, flowers, and fruits; the rudiments of all which beautiful objects, were once hidden beneath the mould. Little as we should expect to find these in such a bed, as little should we have supposed the dust upon the wings of a butterfly to be minute feathers, or the bloom of a peach to be a collection of insects, had not the microscope furnished us with this intelligence.

'How sweet to muse upon His skill display'd,
Infinite skill! in all that he has made;
To trace in Nature's most minute design
The signature and stamp of Power Divine;
Contrivance exquisite express'd with ease,
Where unassisted sight no beauty sees;
The shapely limb, and lubricated joint
Within the small dimensions of a point;

Muscle and nerve miraculously spun,
His mighty work who speaks, and it is done.
Th' invisible in things scarce seen reveal'd;
To whom an atom is an ample field.'

The microscope endows us, as it were, with a new sense: unfolds the amazing operations of Nature, and displays to us wonders unimagined by former ages. Who, a thousand years ago, would have thought it possible to distinguish myriads of living creatures in a single drop of water? That the purple tide of life, and even the globules of the blood, should be seen distinctly, rolling through veins and arteries, smaller than the finest hair? That not only the exterior form, but even the internal structure, and the motion of the fluids in a gnat, should be rendered visible? Or, that numberless species of creatures should be made objects of vision, though so minute, that a million of them are less than a grain of sand? These are noble discoveries, on which a new philosophy has been raised, that enlarges the capacity of the human understanding, and affords more sublime and just ideas than mankind had before, of the infinite power, wisdom, and goodness of the Great Creator.

'The artificial convex will reveal
The forms diminutive that each conceal;
Some so minute, that, to the one extreme,
The mite a large leviathan would seem;
That yet of organs, function's sense partake,
Equal with animals of larger make.

In curious limbs and clothing they surpass
By far the comeliest of the bulky mass.
A world of beauties! that through all their frame
Creation's grandest miracles proclaim.'

It was an observation of the excellent Mr. Boyle, that his wonder dwelt not so much on Nature's clocks as on her watches. And, indeed, if we compare the structure of an elephant with that of a mite, we shall perceive the justness of his remark. With whatever degree of surprise, or even of terror, we may at first consider the huge bulk and prodigious strength of the elephant, we shall find our astonishment still greater, if we attentively examine the minute parts of a mite. The mite has more limbs than the elephant; each of them furnished with veins and arteries, nerves, muscles, tendons, and bones; it has eyes, a mouth, and a proboscis too, as well as the elephant, to take in its nourishment, a heart to propel the circulation of the blood, a brain to supply nerves in every part, and other organs as perfect as in the largest animal. Now, if the extreme minuteness of these parts is not

merely surprising, but far above our utmost conception, what shall we say to those various species of animalcules, to which the mite itself, in size, is as it were an elephant? Inconceivable as it may appear, it is yet a fact, that a mite upon a cheese is as large and considerable, in proportion, as a man upon the earth. The little insects that feed upon the leaves of peach-trees are no inappropriate representation of oxen grazing in large pastures; and the animalcules in a drop of water swim about with as much freedom as whales do in an ocean. They have all equal room in proportion to their bulk. In each, too, the organization is as perfect as in the others; and the quantity of life and activity seems not in the least diminished, though the parts in which they are seated be so small as to elude our observation.

In pursuing this subject, we shall confine ourselves to the description of Gould's pocket microscope, which we deem the best for scientific purposes, and its application to objects of natural history.

The extreme portability and great magnifying power of this microscope will recommend it strongly to the naturalist, mineralogist, and botanist, as it has sufficient powers to discover the most minute animalcule and seed vessels; it combines the uses of the Single, Compound, Opaque, and Aquatic microscopes; and has been found, upon comparison, by several scientific gentlemen, superior in power, and more distinct than many of the largest and most expensive instruments of the kind;—it shuts up in a case, three inches by three and a half, and may be carried in the pocket without the slightest inconvenience.

DESCRIPTION OF THE PLATE.

A—The microscope, as it lies in its case, the body and pillars taken out, to show the apparatus underneath.

B—The Compound Body.

C—The Pillar on which is fixed the stage—Fig. 2, and reflecting mirror—Fig. 3. These remain on the pillar when put into the case, for the convenience of packing.

D—The Arm may be taken off and used as a hand microscope—Fig. N.

E—The different powers, Nos. 4, 5, 6. These are screwed on to the arm, and in them the body, but each may be used singly for large or opaque objects without the body. Nos. 1 and 2 may be combined; No. 6, being the highest power, is not to be combined with either 4 or 5.

F—The Object-Box, which unscrews to place live objects in, such as mites from cheese; this is placed on the stage.

G—A moveable piece, to place on the stage, Fig. 2, for holding objects.

H—Slides filled with curious objects.

I—A Pair of Steel-Pointed Forceps, which open by pressing the two brass pins, for holding flies, or pieces of card with opaque objects on them; this is placed in the hole on the stage or on the arm, when used as a hand-microscope—Fig. N.

L—The whole instrument put together for use.

N—The Arm converted into a hand microscope.

P—Two Pieces of Glass sealed together for holding a drop of water.

R—A circular Piece of Glass for placing on the stage G to hold any object.

7 and 8—A Dissecting-Knife and Point; a Pair of Brass Forceps, for taking up small objects, with a spoon at the end for taking up a single drop of water, for placing between the two glasses to view the animalcule; a small brush for taking the mites from cheese, farina from flowers, and other delicate objects.

DIRECTIONS FOR PUTTING THE MICROSCOPE TOGETHER. First take out the pillar, on which is fixed the stage and reflecting mirror; screw it on the brass-piece on the side of the box; turn the mirror to face the light, and move the stage to the centre of the pillar by means of the rack and pinion; place one of the powers on the body, and screw it into the arm: you must now get a clear and distinct field; this you will obtain by moving the mirror to the proper angle to reflect the light, at the same time looking through the microscope: now place the object to be examined on the stage; get the proper focus of the lens, by moving the stage up and down by means of the milled head, fig. 9. To place the slides in the stage, press down with the fingers the brass spring underneath; as an improvement for viewing objects generally, the moveable piece G is placed upon the fixed stage, fig. 2; it may be moved by the finger and thumb, with the greatest delicacy, in any direction; the object to be examined being placed upon the circular piece of glass. To place the pillar again in the case, let the stage be brought close up to the arm, and the mirror turned round; they will then fit into their place without being separated from the pillar. It is more difficult to get the reflected light with the candle than by day-light, but many of the objects appear to much greater advantage; the candle should be placed at the distance of about twelve inches, not too high, and in a straight line with the mirror.

DESCRIPTION AND APPLICATION OF THE DIFFERENT POWERS. This microscope has four different powers, so arranged

that objects may be viewed, from the size of a large beetle or moth to the most minute animalcule. These powers are marked Nos. 4, 5, 6; No. 4 is the lowest power, and is calculated for viewing opaque and large objects, and should be used without the body; No. 5 is the next power, and is calculated for viewing all the objects of the size of those in the slides; the next power is produced by combining the Nos. 4 and 5 together, which may be called the third power; it magnifies twenty-five hundred times, and is adapted for viewing the animalcules, &c. The greater power is in a conical cell, marked No. 6; with this power an object is magnified twenty-six thousand times with the body, which is equal to the largest compound microscopes; it should only be used for extreme minute objects, and without either of the other powers: as the object and the lens come extremely near when it is used, care must be taken, by a very delicate movement of the stage, that they do not come in contact with each other in getting the proper focus. To prevent this, if a drop of water is to be examined, place it between the slips of glass, and if these will not admit the lens to come near enough, place a piece of thin talc upon it. Objects should first be viewed with the low powers, that the whole of them may be seen, and the highest ones can then be used in gradation.

Objects for the Microscope. In the summer months, the waters, as well as the hedges, abound with living wonders for the Microscope, and afford an endless amusement to the admirers of the works of nature in the minute creation.

Best Method of procuring Aquatic Insects. In the ponds and ditches that are covered with duck-weed, surprising insects may be found: some of this weed should be procured, and put into a white earthen vessel; it will be a never-failing supply of living, and most entertaining objects for the microscope, and may be kept the whole of the winter months, as the leaves have the valuable property of keeping the water fresh. Every proprietor of a microscope, who would wish to secure a supply of a great variety of interesting living objects in constant readiness, should adopt this method of obtaining them. The decayed leaves will be found best for the purpose; two or three of these being taken out, with a small portion of water, on a piece of glass, gently press them, and the wheel animal, as well as many others, will come out from the cells in which they have taken up their abode. The bell-shaped polype, the proteus, and other smaller kinds of animalcules, may thus be had in great numbers.

Those that are visible to the eye may be easily procured by the aid of a small landing-net made with stout wire and book muslin: bend one end of the wire into a circle and secure it by twisting; the other end will serve for a handle by which it can be attached to a stick; when used, suffer the water to drain away, then reverse the instrument, touching the water (into which the insects are to be transferred) with the muslin, by which means they can be so transferred without injury by handling; a smaller instrument (about one and a half inch diameter) will be found very serviceable, upon the same plan in fishing out the insects; when about to be exhibited, put some clear water in a watch-glass, and reverse the net with the insects into it; any one of them singly may be taken out by means of the small spoon or brush for examination.

Beetles, Moths, &c. Numbers of these may be found by attentively examining the hedges in lanes; almost upon every leaf you may discover some minute living creature. On the grass, a great variety of the beetle tribe may be procured, under stone, in old trunks of trees; in the bark among the heaths and mosses, and in sand-pits; and a great variety of wings and other parts of insects may be found on the webs of the field spiders, most beautifully dissected for the microscope, in a way that could not be done by any other means. Insects of the beetle class are found in the greatest abundance upon heath. Mosses and vegetation on old walls, contain many rare and curious microscopic insects; a quantity of this moss should be procured, put into boxes, and afterwards carefully shaken over a sheet of white paper.

Apparatus for collecting objects. These are simply as follows:—A net of wire gauze for taking insects on the wing. It may be held also expanded under a tree or bush, whilst the branches are beaten with a stout stick, which will cause a number of curious insects to fall into it.

A Landing-Net, for aquatic insects.—A Knife, for extracting objects from the root of trees, bark, &c.

A Strong Phial, corked, with a quill passing through it, for water insects.

A Tin Box, the cover pierced with small holes.

A few Chip Boxes.

Directions for dissecting objects. In dissecting minute insects, as the flea, louse, &c., in order to examine their internal structure, it is necessary to observe great care: they should be placed in a drop of water and examined instantly, or the parts

will shrink up. A delicate lancet, with a pair of the finest scissors and forceps are generally used for such purposes.

MEHTOD OF PREPARING AND APPLYING OBJECTS FOR THE MICROSCOPE. Most objects require a little management, in order to bring them properly before the glasses: if they are flat and transparent, put them between the talc in the slides,—the scales of fishes for instance, &c. In making your collection of objects, if you wish to fill a number of slides, care should be taken to arrange them as near the size of each other as possible in the same slider, in order that they may be examined by the same power. Minute living objects, such as mites in cheese, small insects on vegetables, &c., should be delicately brushed off into the object-box, and shut up; flies, small beetles, &c., may be held by the forceps.

To view the circulation of the blood, &c. in aquatic insects, place them in a small portion of water on a piece of flat glass; two pieces of glass may be made open enough to receive any sized objects of this kind, similar to the animalcule apparatus.

FOR VIEWING ANIMALCULES IN FLUIDS WITH THE GREATEST FACILITY. The great difficulty of viewing animalcules in fluids must have been felt by all who use microscopes. A drop of water placed on a piece of glass forms a convex surface, and when a high power is used, the animalcules are continually getting out of the focus by diving to the bottom, and the drop very soon dries up.

The following contrivance effectually removes these obstacles, when the focus of the power in use will admit one of the pieces of glass to intervene between the surface of the lens and the object.—It consists of two pieces of glass fixed with a small portion of sealing-wax between them, and left open at the top. For viewing animalcules, these pieces should be pressed as close together as possible, but for larger insects they may be left more open. If a single drop of water is taken up by the small spoon at the end of the forceps, and spread over the orifice, it will run in between the two glasses, by which means the surface of the water is rendered perfectly even, and the animalcules are distributed more truly, and confined in a more limited space, whereby their forms and movements become more discernible. This plan also prevents evaporation from the surface, which often dims the lens, and perplexes the observer: a single drop of water may be kept for hours in this way, with any curious animalcule alive in it. The glasses can be cleaned out by introducing a piece of thin writing paper between them, and a drop of pure water. By

leaving sufficient room between the glasses, the larger aquatic insects may be viewed; such as small tadpoles, the ephemera, and the water flea. When animalcules and other minute objects are viewed with a lens of short focus, the following contrivance is simple and useful: upon a suitable piece of glass describe a circle with white paint; when dry, place the drop of water within the circle, and cover it with a very thin piece of talc, the space between the talc and glass, produced by the paint, affords sufficient room for the animalcules to move—the talc (if sufficiently thin) offers no obstruction in bringing the object to the focus of the lens.

SLIDES FOR TRANSPARENT AND OPAQUE OBJECTS. You will find clear slips of glass preferable to talc in forming the slides for transparent objects; they may be prepared in the following manner: take two slips of glass about the size of the ivory slides; then get a piece of writing paper, with holes, of the same size; wet one side of the paper with gum-water, and lay the glass upon it, suffering it to dry; then place your objects in the holes, wet the other side in the same manner, and lay on the other glass: any curious objects may be preserved in this way without danger of their perishing: talc may be applied, as in the preceding article, for deep powers.

OPAQUE OBJECTS. Opaque objects may be prepared for examination in the following way: cut a card or piece of stiff paper the size of the object to be examined; put a little gum-water upon it, and the insect will adhere to it, and may be viewed by placing it under the microscope, on the stage; or by means of the steel forceps it may be held in the hand as in fig. N. For viewing minute opaque objects with a high power, with the body, a strong light must be condensed and thrown down upon them by means of a lens, but the single power or lens is better adapted for that purpose. To preserve curious opaque objects, they may be fixed on some slips of glass with gum-water, and another glass placed over them, cemented together with sealing-wax.

CONCHOLOGY.

NO. V.

OF THE FORMATION OF THE UMBILICUS, PROTUBERANCES, &c. We have hitherto considered only the general formation of shells. In the present section we shall treat of some other circumstances which produce variations in their external figure. Such, for instance, is the formation of the umbilicus, of spines, tubercles, ribs, and other protuberances.

Umbilicus. Univalve shells, which are furnished with a regular spire, may be divided, with regard to their form, into four classes; namely shells having a disk, cylindrical shells, turbinated, and ovoid or egg-shaped shells. These four terms are the most common, which spiral univalve shells assume, and they depend on the manner in which the turns of the spire are applied to the common axis, and the difference in their arrangement. They derive their primitive figure from the small shell while it is yet included in the egg, and probably from that of the external organs of the animal, which is contained in it. But, although all univalve shells may be referred to one or the other of these four principal forms, they exhibit a great variety of slighter shades of difference. Let us now see in what way it may be conceived that the bodies of the animals which inhabit univalve shells, give them a spiral form. If we can suppose that from the first production of these animals, when they begin to be developed, the fibres of one part of the body, such as those of the external surface, are longer than those of the opposite surface, it is obvious that the body of the animal continuing to increase, according to its original tendency, will assume a curved form, the concave part of which will be on that side where the fibres are shortest, and if the long fibres on the external surface, and the short fibres on the internal surface, continue to increase in the same proportion, this must give the body a spiral form; but in this case, the different convolutions of which the animal is composed, will be in the same plane, and can only apply to a small number of shells included in the first division, namely, those which are characterized with having a disk.

The convolutions of the spire which are described by the shell of univalve testaceous animals, and the body which serves as a mould for these, are disposed in different planes. Some other cause, therefore, must operate in producing this deviation. Between the two surfaces of the body of the animal, which is supposed to be furnished, with fibres of different lengths, it is easy

to conceive two other surfaces directly opposite to each other, an upper and an under surface, each of which is included between the two preceding surfaces, but of smaller extent; and it is easy to conceive farther that these two latter surfaces are so formed, that the fibres of the one are longer than the corresponding and opposite fibres of the other. According to this structure, the body of the animal will tend to that surface on which the fibres are shortest, and thus describe, during its developement, a spiral line in different planes, in proportion to the difference of tension between the superior and inferior surface of the body, as well as between the lateral surfaces.

The form of the shell depending on the external form of the body of the animal, the umbilicus, which is a different cavity from that of the opening of the shell in which the animal is contained, and which is seen on the interior surface of some shells, in the centre of the convolutions of the spire, depends entirely on the plane on which the animal has formed the additions to its shell. If the plane of these convolutions has been directed round a conical or eliptical axis, and each convolution of the spire be more or less distant towards the centre of the shell from this hollow point, a shell may be thus formed, whose umbilicus will be more or less open, according to the greater or less degree of separation which the animal must give to the convolutions of the spire, corresponding to its structure. An opposite effect will be observed, if the increase of the convolutions of the spire is supposed to take place round an axis which is so small as to permit them to come in contact with each other. In this case no cavity will be formed in the centre, no appearance of an umbilicus will be seen. But if we conceive that the animal, in enlaying itself, turns round a solid curved figure, in place of a conic axis above alluded to, and that the end of this solid is at the summit of the shell, it is obvious that an opening or an umbilicus of the shape of this solid, will be formed in the shell.

Ribs. The longitudinal elevations which are observed on univalve shells, which run in a transverse direction to the successive growth of the convolutions of the spire, have been denominated *varices*, by Linnæus, in allusion to the dilated veins on the bodies of other animals. They are composed of one or more elevations, usually arranged in a line parallel to the axis of the shell, and sometimes slightly oblique. They consist of the same substance as that of the rest of the shell, but are thicker and always more elevated than the surface of the convolutions of the spire on which they are placed. To explain the manner in which these convolutions are formed, we may examine the opening of all land shells

when arrived at the last stage of their growth. This period is marked in these shells by a kind of margin of about a line in breadth, which is sometimes turned outwards, although the rest of the shell turns on a regular, spiral line. This reflected margin never appears in land shells, but when they have reached the last period of their growth, and when it is once formed, the animal of some species ceases afterwards to continue the convolutions of its spire. Having now arrived at that period of its growth, when it is fit to perform the act of generation, it protrudes itself more frequently from its shell, and each time it returns, a viscid fluid which exudes from its neck, is interrupted and deposited on the external margin of the shell. The bulk which the anterior parts of the body have acquired in consequence of the evolution of the generative organs, which are contained in that part of the body, causes it to press more strongly than formerly on the edges of the opening of the shell, every time it protrudes itself, and gradually forces the particles of testaceous matter which have been recently deposited to the external surface, and in direction quite different from that of the former plane of the spire. A short time is only requisite for the complete formation of this elevation; but after it has been formed, if the animal has the power of continuing the spire on the former plane, the shells which had arrived at a larger size, will exhibit from time to time, if the same process be repeated, longitudinal projecting ribs, convex or bent, exactly similar to the external swelling of the opening of the shell, and analagous to the *varices* which are seen on some species of marine shells.

This power of continuing the spire, after the formation of the eminence at the opening, is peculiar to sea shells. No farther increase, after it is once formed in land shells takes place. The young of some sea shells, as some species of *murex*, also possess this faculty of continuing the growth of shells after the formation of similar elevations, even from the earliest period of their existence, and long before it can be supposed that the organs of generation are evolved. This no doubt depends on some peculiar structure or organization of the animal; and particularly on those of the anterior parts of the body.

Tubercles. Many shells are furnished with tubercles, which are produced by the same organs as the rest of the shell. The fleshy protuberances which are placed on the external surface of the neck of the animals which inhabit them, serve as a mould, and according as there are more or less of these tubercles, while the animal enlarges the turn of the spire, and increases its shell so much, there is the same number of protuberances in the convolution. These protuberances, while they remain on that part of

the body of the animal on which they were formed, are hollow, and during the remaining part of its existence, as the body enlarges, they are partly hollow, and partly solid, being filled with testaceous matter, excreted from the body of the animal, and then the internal surface of the shell becomes smooth and even.

Spines, and fringed or irregular protuberances, with which some shells are armed, have, according to all appearance, the same origin as the other inequalities on the external surface of shells. They are usually formed at the end of the different successive periods of the growth of the shell. This will be sufficiently obvious, if we trace the whole series of wrinkles or striæ which run parallel to the circumference of the opening. Those which arise immediately from the ribs or *varices*, are produced by particular organs which surround the extremity of the neck, and stretch out from every part of its circumference, secreting a testaceous matter, which partly forms a sheath around them, gradually increases in thickness, and successively assumes the form of that part of the body which in some measure serves the purpose of a mould. In all the species of murex, which are furnished with spines, the elevation called the varices, or ribs as well as the spines with which they are armed, are placed on the shell at equal distances, and the intermediate parts of the shell, although frequently grooved or striæted, are not furnished with spines.

This uniform observation, not only in shells belonging to this genus, but also in almost all spinous shells, proves, that the spines as well as the ribs, are to be considered as formed by the margin of the anterior parts of the body, which is renewed in the same proportion as the change in the position of this part of the body takes place. It proves also, that the formation of shells is entirely owing to the successive and regular enlargement of the animal; and that it increases every time it is displaced from the whole extent in breadth of the anterior part of the body, the margin of which, only being furnished with long, fleshy processes or fringed appendices, is in reality the only part which produces them on the shell at each period of its increase. In the same way is formed the beak or prolongation of the shell, which terminates the inferior extremity in the form of a canal. This canal is produced in all shells in which it exists, by a cylindrical organ, susceptible of extension and contraction, and which, according to some naturalists, is employed by the animal as a kind of feeler, and occasionally to attach itself to solid bodies. It excretes and deposits a testaceous layer which serves it as a kind of sheath, in a similar manner to the production of spines.

It is easy to explain the formation of the grooves or elevated

ribs which are found on the outer surface of other shells; while the whole of the internal surface is smooth and polished. In bivalve shells, which exhibit this structure, the whole anterior surface of the animal is grooved or channelled in the same way; and from this, the shell derives its shape and structure. In these shells it may be observed, that it is only the anterior margin that is grooved on the internal surface; because in the progress of the growth of the animal, that part of the body which presents a smooth, equal surface has advanced, and nearly filled the whole of the shell; and the testaceous matter secreted from this part of the body being deposited on the grooves, channels, or striæ, which were formed when the anterior part of the body occupied that part of the shell, fills them up completely, and leaves the surface quite smooth and polished. New additions being made to the shell as the growth of the animal requires it, the smooth surface of the body advances forward, and fills up with secretions what is now grooved; while the new part of the shell which corresponds to that part of the body which has an unequal surface, only presents this appearance. It is in this way that the ribs or grooves are formed in different species of ostrea, cardium, and other bivalve shells.

But there is a peculiarity of structure in a species of cockle, the white fluted or ribbed cockle, *Cardium costatum*, which seems more difficult of explanation in its mode of formation.

The ribs of this species are not only of the usual structure of other species of ribbed or grooved shells, but are particularly distinguished by having them hollow. The whole number of the ribs amounts to about eighteen on each valve, of which the eleven exterior ones are of a triangular form, of about three lines high, and hollowed through their whole length, from the beak to the margin of the valves. To have a distinct notion of the formation of these hollow, triangular ribs, it is necessary to conceive, that the margin of the anterior parts of the animal, is deeply channeled or grooved; and when this part is in contact with the recent shell, the ribs or elevations are formed, and are then open to the internal surface of the shell; but the posterior part of the body being hard and smooth, never comes in contact with the excavated part of the ribs. On the contrary, as the testaceous matter is excreted from this part of the body, it is deposited on that part of the internal surface of the shell which it touches, stretches across the deep grooves, and forms the third and interior side of the triangular ribs. Thus it appears, that spines, tubercles, and all other protuberances on the surface of bivalve shells, owe the peculiarity of their form and shape to the peculiar structure of dif-

ferent organs situated on the anterior margin of the body of the animal, and composed of the testaceous matter which is excreted by these organs.

The nature of the process is the same as in univalve shells of a spiral form. The diversity only appears in the difference of the organs, and structure of the animals which inhabit different shells. To a similar process may be ascribed the formation of striæ, of scales, and of various excavations which sometimes accompany them.

ORNITHOLOGY.

NO. VII.

PULVERIZING OF BIRDS. Among the singularity of manners, perhaps there is none more extraordinary than that which seems peculiar to a few species; by some, called *pulverizing*, which is that of dusting themselves; it is observable only in the gallinaceous tribe; the sky lark, wood lark and house sparrow. These are frequently seen in hot weather to roll themselves in the dust, and by means of their wings and legs, throw it all over their bodies. For what purpose it is intended, is difficult to ascertain. Some have imagined it is to destroy the *pediculi* with which these birds abound; but as all other birds are troubled with lice, and do not pulverize, the opinion does not seem to be well founded. Others have supposed that it is to cool themselves, and, that such birds do not wash; but in this also they are mistaken, for no bird *bathes more* frequently than the sparrow.

WALK OF BIRDS. All aquatic birds and waders walk or run in the ordinary manner, placing one leg before the other alternately; but a greater portion of the smaller land birds hop or rather jump along, as if their legs were tied together.

SWIMMING OF BIRDS. The superior velocity with which aquatic birds swim under water, has not wholly escaped notice; but it is not entirely produced by the action of the wings, which are sometimes used as fins to accelerate the motion, but is occasioned by the pressure of the water above. In swimming on the surface, a bird has two motions; one upward, the other forward at every stroke of the feet; so, that when covered with water, that force which was lost by the upward motion, is all directed to the progressive, by which it is enabled to pursue its prey, or to

escape an enemy with incredible speed. The otter and water rat swim much faster under water, than they do upon the surface.

Sleep of Birds. Like horses and some other quadrupeds, a great number of birds sleep standing; the perchers, for example, usually sleep standing on one leg upon some tree, brush or other elevation, with the head turned behind, and the bill thrust under the feathers on the back, or under the wing. Indeed these appear to be the general habits of the whole race of birds, in regard to their mode of resting and sleep; for the duck and goose, although they do not perch, will frequently sleep standing on one leg upon the ground, with their heads turned round, and their bills under their wing. Poultry, although they invariably perch, if a perch can be obtained, do not, when sleeping, rest usually on one leg; but they sink down with their bodies upon the perch, having their legs compressed under them. The sky lark sleeps upon the ground with his legs also similarly compressed. It is probable also that all the tribes of birds, even the perchers, occasionally sink down with their bodies resting on the perch during their soundest sleep. What is very remarkable in the structure of their feet and legs, is, that the greater the weight upon the muscles, the more firmly the claws grasp whatever they lay hold of; hence the cause that birds do not fall down in sleep, although most of their senses are dormant.

The motion of the branches of trees, produced by the wind, increases, doubtless, the disposition for sleep in many birds; this may be exemplified by the common fowl: for placing its bill under the wing, even in broad day light, and swaying it to and fro in the hand for a very short time, will produce sleep. Most of the tribes of birds sleep during the night; but there are many exceptions to this. Owls in particular, are, during the night, much more active than in the day; their sight, similar to that of cats, appears to serve them best in the dark. Many of the duck tribe are not only wakeful, but feed during the night. The nightingale and whip-poor-will are also wakeful while in song, during a considerable portion of the night.

CABINET CYCLOPÆDIA.

SILK MANUFACTURE.

NO. VII.

DISEASES OF SILKWORMS. 'The silkworm is said to be subject to many diseases. There is reason for believing that most, or all of these, are either the consequences of bad treatment, or are easily counteracted by simple remedies. Count Dandolo, to whose recorded experience reference has so often been made in these pages, was obliged to have recourse to other cultivators for the means of describing diseases that did not exist in his own establishment.

'The custom which prevails in Italy and France, of distributing silkworms to be reared in the dwellings of the peasantry, has confined the management principally to the hands of ignorance and prejudice; and little or no improvement had in consequence been made in this part of rural economy, until count Dandolo devoted himself to its reformation, and thereby promoted a branch of industry highly important to the prosperity of his native country. This nobleman pursued the occupation with patriotic and philosophic aims far different from such as usually characterize pursuits of business. He brought scientific knowledge and enlightened views to the subject, and afforded a clear exemplification of the fact, that there is no process, however simple, no employments, however humble, and which might apparently be consigned without injury to the hands of the untaught and unreflecting, that do not call for the head, as well as the hand of man, to conduct them on rational principles, and to derive from them all the beneficial results they may be made capable of yielding. It is seldom that objects of profit are thus undertaken and pursued. It most generally happens, that toils of this nature are assumed from necessity, by persons who think only of rendering them subservient to the calls of that necessity; who have neither mind nor leisure for experiments; and who, if, by departing from the beaten track, they have made a greater proficiency than their rivals, are too prone to keep secret their discoveries with a view to individual advantage. Count Dandolo was not thus satisfied to find out and to pursue the most advantageous methods, but widely disseminated the knowledge of his mode of treatment, not only by his writings, but by inviting the great proprietors, his countrymen, to send pupils to him, who might obtain practical instruction in his methods. These pupils sometimes occasioned great losses to

him, as in order to their acquiring the necessary degree of skill, they were sometimes allowed to act upon their own suggestions. "But this signifies little," he would say, "compared to the advantage of diffusing and naturalising the improved art of rearing silkworms by means of these pupils." Shortly after the publication of his treatise, large establishments were formed in Lombardy, according to his recommendation: these were called *Dandolières*, as a testimony of respect for his disinterested philanthropy.

'The causes which principally engender diseases in the silkworm, appear to exist in either damp, stagnate, or mephitic air. Some experiments, tried in order to ascertain the fact, show, that damp air is even more prejudicial to them, than mephitic (carbonic acid) gas. If a silkworm be introduced into a receiver charged with carbonic acid gas, and in which a bird would instantly die, although the worm quickly exhibits signs of uneasiness and suffering, it will live for ten, fifteen, or perhaps twenty minutes: no warm-blooded animal could continue alive in such an atmosphere for half that time. If, after remaining a few minutes, the worm be withdrawn from the receiver, it will not exhibit any sign of injury, but will be, apparently, as healthy as before inhaling this pernicious gas. The silkworm appears endued with the power to seize upon the minutest portion of vital air which may be held by water, as it will live for some minutes immersed in this fluid, particularly in its first ages; and, even when seemingly dead, it will revive if taken out. It would seem, however, that when its power of breathing is obstructed, the worm instantly dies: if, instead of plunging it in carbonic acid gas, or in water, its eighteen breathing holes are sealed up with grease, it expires instantaneously.

'If a healthy silkworm be confined in a vessel, the air in which, is charged with moisture, and heated to the temperature of 88° or 90°, it will very soon exhibit symptoms of indisposition, and reject food; the skin will slacken, the muscles soften, and contraction cease. In a short time evaporation will be obstructed, the secretions indespensable to vitality, which are effected in this animal by means of contraction,* will be suspended, and ere long it will perish. A warm-blooded animal, on the contrary, if sufficiently supplied with pure air, can live without any suffering, and perform all its functions without inconvenience, in such a temperature, whatever be the attendant degree of moisture. This proves how different is the structure of these two classes of animals.

* The skin of the silkworm has so great a power of contraction, that on being cut through it shrinks in the manner of an elastic substance that has been drawn out.

'In the southern departments of France, it is very common to see silkworms attacked by a disease, which, in consequence of the color assumed by them, is called the jaundice. Very careful examination is continually made for the discovery and removal of worms which may be thus attacked, lest the disease, which is contagious, should spread to others. It is stated in the Bulletin Universel, that the abbè Eperic of Carpentras had recourse in this case to a remedy, or rather a preventive, which, though apparently dangerous, has been justified by the uniform success of twenty years. By means of a fine silk sieve he powdered his worms with quicklime, and after this gave them mulberry leaves moistened with a few drops of wine; these, the insects instantly commenced devouring with an eagerness greater than that which they usually exhibited, and not one of the hurdles, upon which the worms were thus treated, ever appeared infected with jaundice. It was at first supposed, that the cocoons might be injured by this process; but this is not the case, and the method is now very frequently adopted in the department of Vaucluse.

'It is well known, that decayed leaves emit mephitic air abundantly, and the lime may have been efficacious in absorbing and fixing this as it was generated, leaving the atmosphere inhaled by the insects in a desirable state of purity.

'Mons. Blanchard records the following experiment, which satisfactorily proves the efficacy of the use of lime:—"I procured," he said, "four glass jars, nine inches deep, and five in diameter, and provided them with cork stoppers. In each of these glasses I placed twelve silkworms at their second age; these were fed four times a day, and I confined them in this kind of prison all their lives, without taking away either their dead companions or their litter. I sprinkled with lime the worms of only two of these jars, and kept the two others to compare with them. In those without lime, I never obtained more, or less than three, small and imperfect cocoons, and in the two that were sprinkled with lime I had very often twelve, and never less than nine fine full-sized firm cocoons." Mons. Blanchard ascertained, by many trials, that the worms were not incommoded when covered with a large portion of lime.

'Count Dandolo advises fumigation with chlorine gas; but the mode of producing this from black oxide of manganese, common salt, and sulphuric acid, might be attended with unpleasant consequences, if intrusted to ignorant or careless hands, and to inhale the vapor, as generated, is not only unpleasant but dangerous. Chloride of lime, the use of which, is attended with highly beneficial results, as a disinfectant, and in neutralising the pernicious ef-

fects of mephitic vapors, might prove advantageous in silkworm establishments, producing all the good effects of fumigation with chlorine gas, without hazarding any of the pernicious results which might accompany the latter application.

'Among the peasants of France and Italy, there is a practice of fumigating the room where the insects are kept, with some kind of aromatic gum or odoriferous plant, but these only serve to conceal without correcting the effluvia, which should warn the attendants of the necessity for cleanliness, and instead of removing, increase the evil.

'An almost incredible quantity of fluid is constantly disengaged by evaporation from the bodies of the insects; and if means be not taken to disperse this as it is produced, another cause of unwholesomeness in the air arises. Noticing this, count Dandolo observes, "This series of causes of the deterioration of the air which the worms must inhale, may be termed a continued conspiracy against their health and life; and their resisting it, and living through it, shows them to have great strength of constitution."

'Before this nobleman so zealously undertook the work of reform, the poor silkworms had to struggle through a miserable existence, until, their numbers thinned by death, and their frames weakened by disease, they feebly began to spin that thread, which would have been produced superior in quality and much greater in quantity, had they been more judiciously tended. By his methodical arrangements, the accidents of seasons and external temperature are no longer formidable. In 1814, a year peculiarly unfavorable for rearing these insects, and which proved extensively fatal in other establishments, he continued his operations with the same unvaried regularity, and, with perhaps increased precautions, was ultimately rewarded by the usual success.

'In noticing the system already mentioned of distributing silkworms among the dwellings of the peasantry, count Dandolo gives the following distressing picture:—"In general the rooms appropriated to rearing silkworms among the tenants, farmers, and common cultivators, have the appearance of catacombs; I say in general, for there are some few who, although they may not have all the requisites for rearing worms in perfection, yet have care sufficient to preserve them from any very serious disease.

'I have found, on entering the rooms in which these insects were reared, that they were damp, ill lighted by lamps fed with rancid oil; the air corrupt and stagnant to a degree that impeded respiration; disagreeable effluvia disguised with aromatics; the wickers too close together, covered with fermenting litter upon which the silkworms were pining. The air was never renewed,

except by the breaches which time had worn in the doors and windows; and what made this more sad and deplorable, was the knowledge that the persons who attended to these insects, however healthy they might have been, when they entered upon the employment, lost their health, their voices became hollow, their hues pallid, and they had the appearance of valetudinarians, as if issuing from the very tombs, or recovering from some dreadful illness."

THE LOBSTER.

'With all the voracious appetites of fishes, the lobster is condemned to lead an insect life at the bottom of the water; and though pressed by continual hunger, they are often obliged to wait till accident brings them their prey. Though without any warmth in their bodies, or even red blood circulating through their veins, they are animals wonderfully voracious. Whatever they seize upon, that has life, is sure to perish, though ever so well defended: they even devour each other; and, to increase our surprise still more, they may, in some measure, be said to eat themselves; as they change their shell and their stomach every year, and their old stomach is generally the first morsel that serves to glut the new.

'The lobster is an animal of so extraordinary a form, that those who first see it are apt to mistake the head for the tail; but it is soon discovered that the animal moves with its claws foremost; and that the part which plays within itself by joints, like a coat of armour, is the tail. The mouth, like that of insects, opens the long way of the body, not crossways, as with man, and the higher race of animals. It is furnished with two teeth in the mouth, for the comminution of its food; but as these are not sufficient, it has three more in the stomach; one on each side, and the other below. Between the two teeth there is a fleshy substance, in the shape of a tongue. The intestines consist of one long bowel, which reaches from the mouth to the vent; but what this animal differs in from all others, is, that the spinal marrow is in the breast bone. It is furnished with two long feelers or horns, that issue on each side of the head, that seem to correct the dimness of the sight, and apprize the animal of its danger, or of its prey. The tail, or that jointed instrument at the other end,

is the grand instrument of motion; and with this it can raise itself in the water. Under this we usually see lodged the spawn in great abundance; every pea adhering to the next by a very fine filament, which is scarcely perceivable.

'When the young lobsters are produced, they immediately seek for refuge in the smallest clefts of rocks, and in such like crevices at the bottom of the sea, where the entrance is but small, and the opening can be easily defended. There, without seeming to take any food, they grow larger in a few weeks time, from the mere accidental substances which the water washes to their retreats. By this time also they acquire a hard, firm shell, which furnishes them with both offensive, and defensive armour. They then begin to issue from their fortresses, and boldly creep along the bottom, in hopes of meeting with diminutive plunder. The spawn of fish, the smaller animals of their own kind, but chiefly the worms that keep at the bottom of the sea, supply them with plenty. They keep in this manner close among the rocks, busily employed in scratching up the sand with their claws for worms, or surprising such heedless animals as fall within their grasp: thus they have little to apprehend, except from each other; for in them, as among fishes, the large are the most formidable of all enemies to the small.

'But this life of abundance and security is soon to have a most dangerous interruption; for the body of the lobster still continuing to increase, while its shell remains unalterably the same, the animal becomes too large for its habitation, and imprisoned within the crust that has naturally gathered round it, there comes on a necessity of getting free. The young of this kind, therefore, that grow faster, as we are assured by the fishermen, change their shell oftener than the old who come to their full growth, and who remain in the same shell often for two years together. In general, however, all these animals change their shell once a year; and this is not only a most painful operation, but also subjects them to every danger. Just before casting its shell, it throws itself upon its back, strikes its claws upon each other, and every limb seems to tremble; its feelers are agitated, and the whole body is in violent motion: it then swells itself in an unusual manner, and at last the shell is seen beginning to divide at its junctures. It also seems turned inside out; and its stomach comes away with its shell. After this, by the same operation, it disengages itself of the claws, which burst at the joints; the animal, with a tremulous motion, casting them off as a man would kick off a boot that was too big for him.

'Thus, in a short time, this wonderful creature finds itself at

liberty; but in such a weak and enfeebled state, that it continues for several hours motionless. Indeed, so violent and painful is the operation, that many of them die under it; and those which survive are in such a weakly state for some time, that they neither take food nor venture from their retreats. Immediately after this change, they have not only the softness, but the timidity of a worm. Every animal of the deep is then a powerful enemy, which they can neither escape nor oppose; and this, in fact, is the time when the dogfish, the cod, and the ray, devour them by hundreds. But this state of defenceless imbecility continues for a very short time: the animal, in less than two days, is seen to have the skin that covered its body grown almost as hard as before; its appetite is seen to increase; and, strange to behold! the first object that tempts its gluttony, is its own stomach, which it so lately was disengaged from. This it devours with great eagerness; and, some time after, eats even its former shell. In about forty-eight hours, in proportion to the animal's health and strength, the new shell is perfectly formed, and as hard as that which was but just thrown aside.

'When the lobster is completely equipped in its new shell, it then appears how much it has grown in the space of a very few days; the dimensions of the old shell being compared with those of the new, it will be found that the creature is increased above a third in its size; and, like a boy that has outgrown his clothes, it seems wonderful how the deserted shell was able to contain so great an animal as entirely fills up the new.

'The creature thus furnished, not only with a complete covering, but also a greater share of strength and courage, ventures more boldly among the animals at the bottom; and not a week passes that in its combats it does not suffer some mutilation. A joint, or even a whole claw, is sometimes snapped off in these encounters. At certain seasons of the year, these animals never meet each other without an engagement. In these, to come off with the loss of a leg, or even a claw, is considered as no great calamity; the victor carries off the spoil to feast upon at his leisure, while the other retires from the defeat to wait for a thorough repair. This repair is not long in procuring. From the place where the joint of the claw was cut away, is seen, in a most surprising manner to burgeon out the beginning of a new claw. This, if observed at first, is small and tender, but grows, in the space of three weeks, to be almost as large and as powerful as the old one. We say almost as large, for it never arrives to the full size; and this is the reason we generally find the claws of the lobsters of unequal magnitude.

'Of this extraordinary, yet well known animal, there are

many varieties, with some differences in the claws, but little in the habits or conformation. It is found above three feet long; and, if we may admit the shrimp and the prawn into the class, though unfurnished with claws, it is seen not above an inch. These all live in the water, and can bear its absence for but a few hours. The shell is black when taken out of the water, but turns red by boiling. The most common way of taking the lobster is in a basket, or pot, as the fishermen call it, made of wicker work, in which they put the bait, and then throw it to the bottom of the sea, in six or ten fathom water. The lobsters creep into this for the sake of the bait, but are not able to get out again. The river crawfish differs little from the lobster, but that the one will live only in fresh water, and the other will thrive only in the sea.'

Buffon's Natural History.

THE WHITE OAK.

Quercus alba.

Fig. 1 A leaf. Fig. 2. The fruit.

THROUGHOUT the United States and Canada, this tree is known by the name of *White Oak*. The environs of a small town of *Trois Rivieres* in Canada, latitude 46° 20′, and the lower part of the river Kennebeck, in the state of Maine, are the most northern points at which this tree grows. Thence, we trace it along the sea shore to a distance beyond Cape Cannaveral, latitude 28 degrees, and westward from the ocean to Illinois, an extent of more than twelve hundred miles from north-east to south-west. It is, however, by no means equally diffused over this vast tract; in the state of Maine, Vermont and Lower Canada, it is little multiplied, and its vegetation

is repressed by the severity of the winter. In the lower part of the Southern States, in the Floridas and Lower Louisiana, it is found only on the borders of the swamps with a few other trees, which, likewise, shun a dry and barren soil. The white oak is observed also to be uncommon on lands of extraordinary fertility, like those of Kentucky and Tennessee, and of all the spacious valleys watered by the western rivers. It abounds chiefly in the Middle States, particularly in that part of Pennsylvania and Virginia which lie between the Alleghanies and the Ohio, a distance of about one hundred and fifty miles, where nine-tenths of the forests are frequently composed of these trees, whose healthful appearance evinces the favorable nature of the soil. East of the mountains, this tree is found in every exposure, and in every soil which is not extremely dry or subject to long inundations; but the largest stocks grow in humid places. In the western districts, where it composes entire forests, the face of the country is undulated, and the yellow soil, consisting partly of clay with calcareous stones, yields abundant crops of wheat.

The white oak attains the elevation of seventy or eighty feet with a diameter of six or seven feet; but its proportions vary with the soil and climate. The leaves are regularly and obliquely divided into oblong, rounded lobes, destitute of points: the sections are deepest in the most humid soils. Soon after their unfolding, they are reddish above, and white and downy beneath; when fully grown, they are smooth and of a light green on the upper surface and glaucous beneath. In autumn they change to a bright violet color, and form an agreeable contrast with the surrounding foliage which has not yet suffered by the frost. This is the only oak on which a few of the dried leaves persist till the circulation is renewed in the spring. By this peculiarity and by the whiteness of the bark, from which it derives its name, it is easily distinguishable in the winter. This tree puts forth flowers in May, which are succeeded by acorns of an oval form, large, very sweet, contained in rough, shallow, grayish cups, and borne singly or in pairs, by peduncles eight or ten lines in length, attached as in all species of annual fructification, to the shoots of the season. The fruit of the white oak is rarely abundant, and frequently for several years in succession a few handfuls of acorns could hardly be collected in a large forest where the tree is multiplied. Some stocks produce acorns of a deep blue color.

The bark of the trunk of the white oak is often variegated with large, black spots. On stocks of less than sixteen inches in diameter the epidermis is divided into squares; on old trees, growing in moist grounds, it is in the form of plates laterally attached.

The wood is reddish, and very similar to that of the European oak, though lighter and less compact: in the American species the vessels which occupy the intervals of the concentric circles are visibly less replete. But of all the American oaks, this is the best and the most generally used, being strong, durable, and of large dimensions. It is less employed than formerly in building, only because it is scarcer and more costly. The excellent properties of this wood cause it to be preferred for a great variety of uses, among which are many articles manufactured by the wheelwrights. White oak perfectly seasoned is employed for the frames of coaches, waggons and sledges, for the mould boards of ploughs, the felloes, spokes and naves of wheels. The wood of the young stocks is very elastic and is susceptible of minute division, hence it is preferred for large baskets used in harvesting, for the hoops of seives, the bottoms of riddles and the handles of coach whips; for pail handles and axe helves. In many parts of the Middle States, the white oak is selected for the posts of rural fence. The bark is considered by many tanners as the best for preparing leather for saddles and other similar objects; it is little employed, however, because the bark of the trunk and large limbs only is employed, and on these the cellular integument is much thinner in the white, than in the red and black oaks. The white oak furnishes staves of the best quality, of which are made casks for wine and spirituous liquors. The domestic consumption for this purpose is immense, and vast quantities are exported to the West Indies, Great Britain, and the islands of Madeira and Teneriffe. The young stocks are very elastic and are used for hoops. Among the uses of this wood, the most important is in ship building. In all the dock yards of the Northern and Middle States, except Maine, it is almost exclusively employed for the keel and always for the lower part of the frame and the sides: it is preferred for the knees when sticks of a proper form can be found. In the smaller ports south of New York, the upper part of the frame is also made of white oak; but such vessels are less esteemed than those constructed of more durable wood. The medicinal properties of oak bark depend on its astringency, and that again on its tannin. The inner bark of the small branches is the strongest, the middle bark next, and the outer bark is almost useless. Internally it may be given in form of decoction, of infusion, or powder, as a tonic and astringent in leucorrhœa, menorrhagia, etc., and also in intermittents. Externally, as a styptic, astringent, and antiseptic, when sprinkled in form of a powder over gangrenous, and ichorous ulcers. Inhaled in the form of impalpable powder it has been known to cure phthisic, even in its advanced stages. *Sylva Americana.*

ON VOLCANOES.

CALORIC, another cause of combustion, whether it be a substance too fine for being found alone, or a mere phenomenon of other bodies, is the grand agent which counteracts the law of gravitation, and enables the motions and functions of life to be carried on. Whatever is melted is melted by fire; and whatever is kept in that state, is so kept by the same. Caloric and ice form water; the component parts of water, with more caloric, becomes oxygen and hydrogen gases; and if these be brought together in the proper proportions and a body applied that can cause them to part with their caloric, water is the result; and by the further abstraction of caloric, that water may be changed to ice. There are powers in natural substances, by which caloric may be made sensible without human aid, and the most remarkable of these are volcanoes. The consideration of those phenomena of nature called volcanoes, of which we have instances in the mountains Ætna and Vesuvius, is very interesting. From these, at different intervals, issue terrible eruptions of fiery matter. Sometimes only a black vapor is seen to arise, and at the same time are heard hollow rumbling noises, often succeeded by strong flashes of fire, and peals like thunder, accompanied with the sensation of an earthquake. The vapor then becomes luminous, and showers of stones and lava are evolved, part of which fall again within the crater, though enough fall without to lay waste the neighboring country, and are sometimes whirled to a considerable distance. These terrible explosions are sometimes even more violent. With the noise of thunder, torrents of burning sulphur, and liquid metals, enveloped with clouds of ashes and smoke, are hurled to an immense distance. Rocks upborne by the force of the explosion, fall with a dreadful crash; and cataracts of fire pour down the steep of the mountain; the deluge pours over villages, plantations, and cities; the earth rocks, and they who escape the flood, fall within the gulf made by the earthquake, or, tossed from wave to wave, are buried in the general wreck.

A volcano, or burning mountain, is a wonderful phenomenon. The crater, that is, orifice or mouth of a volcano, in some cases, is more than a mile across; and from this mouth are emitted torrents of smoke and flame; rivers of bitumen, sulphur, and melted metal, the mixture bearing the name of lava; it ejects clouds of cinders and stones, and sometimes enormous rocks, to many leagues distant, when merely to stir them would baffle the utmost efforts of human strength. The combustion is so terrible, and

the quantity of burnt, melted, calcined, and vitrified materials which is thrown out at the orifice is so plentiful, that they enter towns and forests, cover the fields to more than a hundred feet in thickness, and sometimes form hills and mountains. The action of this fire is so great, and the force of explosion so violent, that its re-action has been known to shake the earth, agitate the sea, overthrow mountains, and raze the most solid edifices and towns, even to very considerable distances. In Europe there are three celebrated volcanoes, namely, mount Ætna in Sicily, mount Hecla in Iceland, and mount Vesuvius in Italy, near Naples. Ætna is unquestionably the most ancient on record; but as no mention is made of its burning or eruption by Homer, who flourished about 980 years before Christ, it is reasonable to suppose that a phenomenon at once so tremendous and extraordinary, did not take place before his time. Pindar, who lived 480 years after Homer, is the first poet who has given us a description of its fiery eruptions. He has feigned the giant Typhœus to be overthrown by Jupiter, and overwhelmed by Ætna, whose agitations and eruptions were caused by his vain attempts to release himself from its incumbent pressure. Of this fiction Mr. West has given the following translation:

Now under sulphurous Cuma's sea-bound coast,
And vast Silicia, lies his shaggy breast;
By snowy Ætna, nurse of endless frost,
The pillar'd prop of heav'n, for ever press'd;

Forth from whose nitrous caverns issuing rise
Pure liquid fountains of tempestuous fire,
And veil in ruddy mists the noon-day skies,
While wrapt in smoke the eddying flames aspire.
Or, gleaming through the night with hideous roar,
Far o'er the redd'ning main huge rocky fragments pour.

But he, Vulcanian monster, to the clouds
The fiercest, hottest inundations throws,
While, with the burden of incumbent woods,
And Ætna's gloomy cliffs, o'erwhelm'd he glows.

There on his flinty bed outstretch'd he lies,
Whose pointed rock his tossing carcass wounds;
There with dismay he strikes beholding eyes,
Or frights the distant ear with horrid sounds.

Whole chains of volcanic mountains are found upon some places of the earth's surface; and there are, in many other places, traces of volcanoes that have become extinct. There seems to be some connexion between volcanoes and the presence of water,

as the extinguished ones are in places that have become dry; and those that are in a state of activity are never far from the sea. The great quantity of caloric that is given out when the component parts of water are condensed into that liquid is probably the cause, or at least one of the causes.

Besides the astonishing explosion of flames and smoke, of cinders and burning rocks, the eruptions of volcanoes exhibit a dreadful phenomenon, in prodigious inundations of liquid fire, which bear inevitable destruction with them. The Italians give the name of *lava* to these fiery streams. This lava consists of a mixture of stones, sand, earth, metallic substances, salt, &c., calcined, rendered fusible, and vitrified by the fire of the volcanoes; but as the mass of which it originally consists, is very heterogeneous, the lava, when cold, appears under various forms and colors. The purest sort is a hard, black, homogeneous, compact glass, and is very abundant in the volcanic parts of Iceland, formed probably of sand and the alkali of sea weed in the bed of the ocean. There is another species which is hard, heavy, and compact, like marble; susceptible of a very fine polish, and converted, at Naples, to a variety of domestic uses. There is another kind, which is a grosser stone, commonly ash-colored, and used both for building, and for paving the streets. That which is found on the surface is still more gross and spongy, resembling the recrements of melted metals. The violent eruption of Vesuvius, in 1767, is reckoned the 27th since that which destroyed the cities of Herculaneum and Pompeii, in the reign of the emperor Titus; and this eruption of 1767, has been succeeded by nine others. Of the eruptions of Ætna, Mr. Holdenburg has given an historical account in the *Philosophical Transactions*, No. xlviii. p. 97. A very great eruption of this mountain took place in the year 1669. The progress of the lava, or fiery deluge above described, was at the rate of a furlong a day. It advanced into the sea 600 yards, and was then a mile in breadth. It had destroyed, in forty days, the habitations of 27,000 persons; and of 20,000 inhabitants of the city of Catania, only 3,000 escaped. This inundation of liquid fire, in its progress, met with a lake four miles in compass, and not only filled it up, although it was four fathoms deep, but raised it into a mountain. Borelli, an ingenious Neapolitan, has calculated, that the matter discharged at this eruption was sufficient to fill a space of 93,838,750 cubit paces. The lava which ran from it, is fourteen miles in length, and in many parts, six in breadth. A mixture of sulphur, filings of iron, and of water, buried at a certain depth below the earth's surface, will exhibit, in miniature, all the appearances of a volcano.

AMERICAN LARCH.

Larix americana.

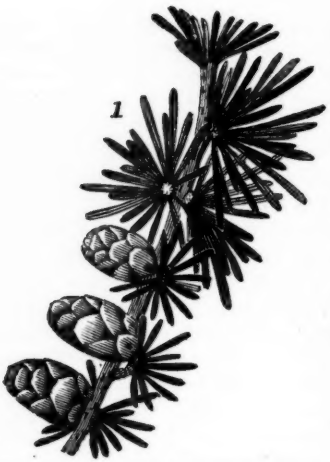

Fig. 1. A Branch with leaves and cones.

In the north of the United States this tree is commonly designated by the name of *Hackmatack*, but we have preferred that of *American Larch*, which is not unknown where the other is habitually used. The French Canadians call it *Epinette rouge*. This tree is most abundant in Vermont, New Hampshire and the state of Maine; but though the soil is well adapted to its growth, and the winter is long and severe, it does not form a hundredth part of the resinous growth, which consists principally of the black and the hemlock spruce and the red cedar. It grows in the Canadas, and extends as far north as Lake St. John; here it begins to abound, and to form masses of woods, some of which are several miles in extent. It is profusely multiplied also in Newfoundland, New Jersey, Pennsylvania and the coldest and most gloomy exposures in the mountainous tracts of Virginia, which are the limits of its appearance towards the south: but it is rare in these states, and in lower Jersey it is seen only in the swamps of white cedar, with which it is scantily mingled. In Vermont, New Hampshire and Maine it grows only in low and moist places, and never on uplands, as about Hudson's Bay and in Newfoundland; hence we may conclude that the climate of the northern part of the United States is too mild for its constitution.

The American larch is a magnificent vegetable with a straight, slender trunk eighty or a hundred feet in height and two or three feet in diameter. Its numerous branches, except near the summit, are horizontal or declining. The bark is smooth and polished on the trunk and lower limbs, and rugged on the lower branches. The leaves are flexible, and collected in bunches: they are shed in the fall and renewed in the spring. The flowers like those of the pines,

are separate upon the same tree: the male aments, which appear before the leaves, are small, oblong and scaly, with two yellow anthers under each scale: the female flowers are also disposed in aments, and are composed of floral leaves covering two ovaries, which, in process of time, become small, erect, scaly cones three or four lines long. At the base of each scale lie two minute winged seeds. On some stocks, the cones are violet-colored in the spring instead of green; but this is an accidental variation, for the trees are in no other respect peculiar.

The wood of the American larch is superior to any species of pine or spruce: it is exceedingly strong and singularly durable. In Canada it is considered as the most valuable timber, and has no fault except its weight. In the state of Maine it is esteemed more than any other species of resinous wood for the knees of vessels, and is always used for this purpose when proper pieces can be obtained. This wood is justly appreciated in the United States, but it is little employed because it is rare and may be replaced with other species which are cheaper and more abundant. *Sylva Americana.*

Vegetable Silk.

The bark of the Papyfera, a species of the mulberry tree, not only furnishes fibres for ropes, but can even be formed into cloth. M. la Rouverie affirms, that he procured a beautiful vegetable silk from the young branches of this tree; cutting the bark while the tree was in sap, and then beating it with mallets and steeping it in water, he obtained a thread from the fibres, almost equal to silk in quality, and this was woven into a cloth whose texture appeared as if formed of that material. The women of Louisiana obtain a similar production from the offshoots of the mulberry; these are gathered when they are about four or five feet high. The bark is stripped and dried in the sun: it is then beaten, to get rid of the external part, which falls off, leaving the inner bark entire. This is again beaten, to make it still finer, after which it is bleached in dew. It is then spun, and various fabrics are made from it, such as nets and fringes; and sometimes it is woven into cloth. The finest sort of cloth among the inhabitants of Otaheite and other of the South Sea Islands, is made of the bark of this tree.

METEOROLOGICAL JOURNAL,

KEPT AT BOSTON, FOR MAY, 1832.

[From the Daily Advertiser.]

	THERMOMETER.			BAROMETER.			FACES OF THE SKY.			DIRECTION OF WINDS.			RAIN.
Day.	*Morn.*	*Noon.*	*Even.*	*Morn.*	*Noon.*	*Even.*	*Morn.*	*Noon.*	*Even.*	*Morn.*	*Noon.*	*Even.*	*Inch.*
1	40	52	44	29.98	29.90	29.90	Cloudy	Cloudy	Fair	S. E.	S. W.	N. W.	
2	40	42	43	30.02	30.05	30.10	Fair	Fair	Cloudy	N. W.	E.	S. W.	
3	44	50	48	30.10	30.10	30.10	Cloudy	Fair	Cloudy	S. W.	E.	S. W.	
4	46	52	57	30 03	29.90	29.72	Cloudy	Fair	Rain	S. W	N. E.	S. W.	
5	42	50	46	29.70	29.73	29.95	Cloudy	Cloudy	Fair	N. E.	N. E.	N. E.	.60
6	41	48	40	30.20	30.25	30.40	Fair	Fair	Fair	N.E.	E.	S. E.	
7	38	49	39	30.50	30 50	30.45	Fair	Fair	Fair	S. W.	E.	S. W.	
8	42	69	55	30.40	30.30	30.23	Cloudy	Fair	Cloudy	S. W.	S. W.	S. W.	
9	56	68	56	30.20	30.22	30.25	Cloudy	Cloudy	Fair	S. W.	N. W.	N. W.	08
10	50	56	46	30.39	30.45	30.50	Fair	Fair	Fair	S. W.	E.	N. W.	
11	40	54	47	30.51	30.52	30.48	Fair	Fair	Fair	N. W.	E.	S. W.	
12	42	75	60	30.39	30.30	30.28	Fair	Fair	Fair	S. W.	S. W.	S. W.	
13	56	78	62	30.22	30.22	30.20	Fair	Fair	Fair	W.	E.	S. W.	
14	60	30	66	30.18	30.18	30.12	Fair	Fair	Fair	S. W.	S. W.	S. W.	
15	63	80	60	30.08	30.02	29.90	Cloudy	Fair	Rain	S. W.	S. W.	S. W.	
16	60	76	60	29.90	29.91	30.01	Fair	Fair	Fair	W.	N. W.	N. W.	
17	52	72	60	30.07	30.03	30.02	Fair	Fair	Fair	W.	N. W.	N. W.	
18	56	56	53	30.02	30.04	30.02	Cloudy	Fair	Fair	N. E.	E.	S. W.	
19	50	50	46	30.01	30.00	29.92	Cloudy	Cloudy	Rain	S. W.	E.	E.	.72
20	51	50	48	29.78	29.80	29.65	Rain	Rain	Rain	S E.	N. W.	N. E.	.55
21	49	52	50	29.43	29.52	29.70	Rain	Cloudy	Fair	N. W.	N. W.	S. W.	1.29
22	49	50	44	29.72	29.91	30.04	Cloudy	Cloudy	Rain	N. W.	N. W.	N. E.	
23	42	50	41	30.10	30.11	30.11	Cloudy	Fair	Cloudy	N. E.	E.	E.	.01
24	43	44	39	30.05	30.02	29.95	Cloudy	Rain	Rain	E.	N. E	N. E.	
25	56	38	40	29.83	29.75	29.80	Rain	Rain	Rain	N. E.	N. W.	S. W.	.20
26	44	51	44	29.69	29.69	29.69	Cloud	Rain	Rain	W.	N. W.	S. E.	.44
27	44	44	42	29.60	29.59	29.76	Rain	Rain	Rain	N. E.	N. E.	N. E.	
28	44	60	49	29.80	29.85	29.90	Cloudy	Fair	Fair	N. W.	N. W.	N. W.	.77
29	46	68	55	29.97	29.97	29.95	Fair	Fair	Fair	N. W.	N. W.	S. W.	
30	51	58	48	29.79	29.61	29.61	Cloudy	Rain	Cloudy	S. W.	S. W.	N. E.	.87
31	48	46	46	29.68	29.90	29.91	Rain	Rain	Rain	N. E.	N. E.	N E.	.43

Depth of rain fallen 5.96 inches.

Hours of observation, at sunrise, 1 o'clock, and 10 P. M.

A Microscopic View of a drop of Water with the different Animalcula magnified 5000 times with the 2nd power of C. Gould's Improved Pocket Compound Microscope.

Pendleton's Lithography Boston